Plant –Microbe Interaction – C:N Ratio

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'Carbon to Nitrogen Ratio' (C: N) , Temperature, Moisture, Aeration and Soil pH affect organic matter decomposition.

High to low C:N of surface residue & other materials.

- **Barley Straw 85:1**
- **Rye Straw 82:1**
- **Wheat Straw 80:1**
- **Oat Straw 70:1**
- **Corn Stalks 60:1**
- **Pea Straw 29:1**
- **Rye Cover Crop 26:1**
- **Mature Alfalfa 25:1**
- **Ideal Microbe Diet 24:1**
- **Clover 21:1**
- **Manure 17:1**
- **Young Alfalfa 15:1**
- **Hairy vetch 11:1**
- **Humus 10:1**
- **Soil microbes 8:1 avg. (ranging 3 – 10:1)**

Slower

Relative Decomposition Rate

Faster

Photosynthesis

Carbon dioxide + water = root exudates + oxygen

$6CO_2 + 5H_2O = C_6H_{12}O_6 + 6O_2$

Energy as fixed Carbon

N_2 fixation by bacteria

NH_4^+

Mineralization: Plant residue, dead microbes or manure with C:N of <30:1 have sufficient N for microorganisms to decompose residues with out taking from the soil. (N>2.5% in crop residues, Va Tech Edu.).

Immobilization happens when C:N ratios of residues exceeds 30:1. Microbes will then take ammonium and nitrate out of the soil to fuel decomposition. (N<1.5% crop residues, Va Tech Edu.).

Chemical

Physical

Biological

A healthy soil is one where there is life!

(C) & (N) are in all dead and living things and serve as the building blocks of plants and animals including: proteins, carbohydrates, lipids, nucleic acids, lignin, and chlorophyll.

A diversity of plants on rangeland and cropland improves nutrient cycling.

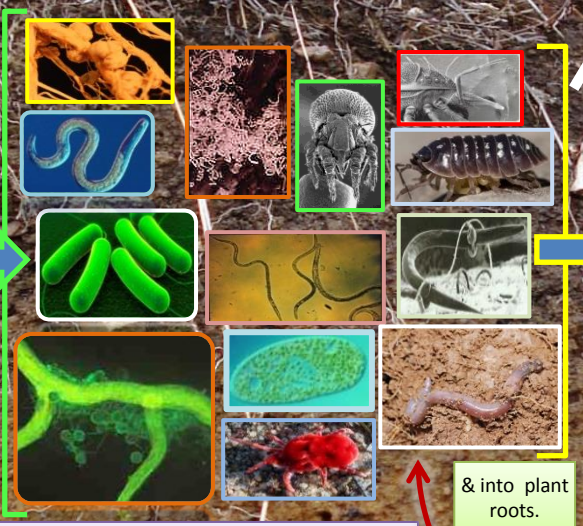
Improved Soil Food Web

in the top few inches of the soil surface.

Soil Microbes need C:N: 24:1 with 16 parts (C) for energy and 8 parts (C) for maintenance.

O_2

No Biology? No Benefit.



CO_2

Plant residues are utilized by a wide diversity of soil biota, including fungi, bacteria, invertebrates and arthropods. Bacteria & Fungi utilize these root exudates / sugars, which mineralize nutrients. Mycorrhizal fungi assist in nutrient & water acquisition.

Soil organisms decompose dead organic matter, plant and animal wastes. There is also a predator / prey relationship between microbes. Microbial activity produces *plant available* Nitrogen and Phosphorus.

& into plant roots.

Mobile/available nutrients are taken up by plants and soil biota or are lost through leaching/run-off and/or volatilization.

Volatilize

Denitrification N_2O, NO, N_2

NH_4^+

free H^+

NH_3

ammonification

Nitrification process

Nitrites NO_2^-

Plus H^+

Nitrates NO_3^-

Anaerobic Denitrification

Soil Aggregates

Fine roots, mycorrhizal hyphae, glomalin, root exudates, microbial by-products and humus bind sand, silt and clay together to create micro and macro aggregates which increases soil stability and maintains optimum functionality of the soil.

Pasture & Range Health

- Adaptive grazing mgt.
- Plant diversity
- Living roots throughout the year
- Cover the soil
- Less disturbance
- Livestock integration

Agronomy Tech Note 76: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nm/technical/?cid=nrcs144p2_068965

Carbon is the currency of exchange between biology and the plant!

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